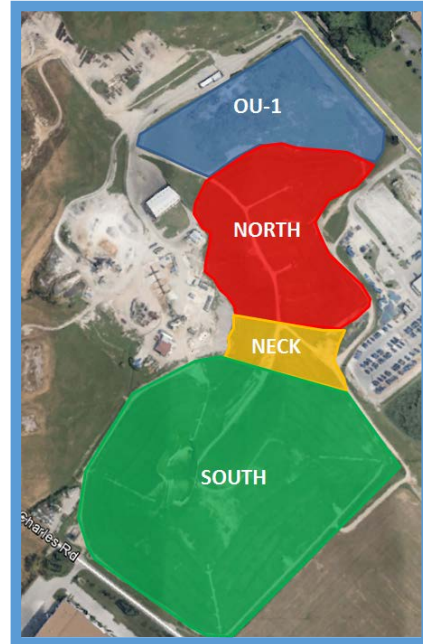


## Bridgeton Landfill Data Review Update

*Primarily Reflects Data and Documents Published on MDNR's Webpage for data collected in March 2016*

### Introductory Remarks

The ORD Engineering Technical Support Center (ETSC) and their subcontractor reviewed data and reports at the Missouri Department of Natural Resources (MDNR) Bridgeton Landfill website. The purpose of the review was to examine available reported data collected at the landfill gas extraction wells (GEWs), gas interceptor wells (GIWs), and temperature monitoring probes (TMPs) to assess the presence and progression of any subsurface oxidation event/heat-generating event occurring in the South Quarry, North Quarry or the adjoining “Neck” area (*see figure on right for an approximate depiction of these areas and the adjacent Westlake Landfill OU-1 cell*). The shaded areas shown in the figure are intended to provide a quick reference to different areas of interest. This report analyzes data primarily collected in March 2016.



The closure of the South Quarry and North Quarry landfill cells was approved by MDNR in 2008 and 2010, respectively. The landfill cells were closed with a 2-ft thick clay cap (with hydraulic conductivity  $< 1 \times 10^{-5}$  cm/sec) overlain by a 1-ft thick vegetative soil layer. An ethylene vinyl alcohol (EVOH) flexible membrane cap was placed over the South Quarry, Neck Area, and a portion of the North Quarry in 2013 and 2014. Work was initiated in the South Quarry at various times in 2014 and 2015 to repair slopes that had subsided. A North Quarry cap enhancement project (approved by MDNR on 27 January 2016) was recently initiated, which includes installing a flexible membrane liner between the edge of the EVOH liner and the perimeter road, along with associated stormwater management and gas management infrastructure. Installation of 15 new GEWs began in the South Quarry in March, and is expected to be completed in April 2016. Additional information on this plan is available on the MDNR website (link above).

This document provides a summary and discussion of data collected in North Quarry, Neck Area, and South Quarry of the landfill. Observations on the flare data are also provided below:

- The average flow rates of methane (CH<sub>4</sub>) (296 standard cubic feet per minute (scfm)) from the flare was less than in February 2016 (338 scfm), and flow of carbon dioxide (CO<sub>2</sub>) (1,065 scfm) was slightly more than in February (1,037 scfm). The balance gas flow rate of 1,286 scfm in March was also slightly more than in February (1,270 scfm).
- The average total flare flow rate of 2,869 scfm in March was less than the average total flare flow rate in February (2,907 scfm).

Flare data are subject to further examination, as subsequent meetings in December 2015 and January 2016 indicated the flow measurements for the overall gas collection system and flares

were not accurate, and flow data for the mentioned systems were not accurately measured until after March 12, 2015 (per MDNR). However, it is our understanding that flow data from individual GEWs and GIWs were accurate throughout 2015 and into 2016.

## **North Quarry**

### **Temperature**

**March 2016 measurements showed three wells that exhibited a decrease in temperature in the middle of the month that also corresponded with a decline in applied vacuum.** The remaining wells exhibited mostly steady temperatures when compared to February 2016 data. The maximum temperature measured in North Quarry wells was 128.9 °F (GEW-51).

Data from several TMPs in the North Quarry (TMP-16 through 18, and TMP-21 through-29) were examined, and the observed temperatures were generally steady in March, with no substantial temperature increases observed, in contrast to temperature observations in February. TMP-26 showed temperature declines at multiple depths of more than 2 °F. TMP-21, -24, and -29 also exhibited more than 2 °F decrease in temperatures at some depths.

**Three TMPs (-16, -17, and -25) had at least one depth with a measured temperature greater than 160 °F, which is the same as seen in February,** although TMP-27 had two depths (60 ft and 80 ft) with a temperature just below 160 °F (> 155 °F). These temperatures are generally consistent with historical values that have not exceeded 160 °F. **Temperatures > 160 °F were observed at two depths in TMP-25, but observed temperatures were less than historical highs at these depths (60 ft and 80 ft).**

### **Collected Gas Quality**

**March 2016 data showed similar trends as February with respect to balance gas, with some wells showing an elevated balance gas concentration. A maximum balance concentration of 27% was measured at GEW-05.** Measured vacuum pressure declined from the previous month, with the majority of wells exhibiting a low or no vacuum (either < 2" water column [w.c.], or positive pressure) for multiple measurements taken throughout the month. Laboratory data suggest that in most cases the elevated balance gas had a higher composition of nitrogen (N<sub>2</sub>). Similar to February measurements, nearly all elevated balance gas measurements were accompanied by a low oxygen (O<sub>2</sub>) concentration (< 2%), suggesting possible air intrusion in the wells with elevated N<sub>2</sub>. The remaining wells exhibited conditions typical of normal anaerobic decomposition.

### **Settlement**

**No settlement data were collected for the North Quarry in March 2016.**

## **Neck Area**

### **Temperature**

**TMP measurements were mostly stable when compared to February data.** Generally, TMPs did not show any increase in temperature across all depths except TMP-3 and -4 at depths 30 ft and 28 ft, respectively; however, the temperature increase was < 2 °F.

**March 2016 data showed steady or increasing temperature trends in the GIWs**, similar to February trends. Temperatures remained < 100 °F for all GIWs retrofitted with the cooling loop system. Most GIWs exhibited strong vacuum at some point during the month, although not all GIWs showed a consistently strong vacuum (e.g., GIW-2 and GIW-3). Three GIWs (-9, -11, and -12) consistently exhibited low vacuum throughout the month.

**GEWs exhibited mostly steady temperature trends, with increased temperatures in some measurements in March.** Applied vacuum remained mostly steady with a few fluctuating measurements that did not appear to drastically affect temperatures. GEW-10 continued to have a large applied vacuum (generally > 15" w.c.), but subsequent increases in temperature were consistent with historical levels.

#### Heat Extraction System (HES) Evaluation

TMPs installed adjacent to GIWs retrofitted with the HES (cooling loop system) were examined and compared to February data. The March data displayed mostly steady or slightly decreasing temperatures. The TMP-5 HES series TMPs showed decreased temperatures (> 2 °F) over multiple depths. Slight temperature increases were observed at a few depths in the TMP-5 HES series. TMP-10-5N showed increasing temperatures at one depth (20 ft), but the maximum temperature was less than historical highs. TMP-10-5S showed a decline at four depths from previous month, with the largest decline at the 20-ft depth of approximately 3.5 °F. **The 140-ft depth at TMP-20 continued showing a temperature increase (approximately 3.5 °F, similar to the month-over-month increase seen from November 2015 to February 2016).**

Similar to February, the TMPs continued showing higher temperatures than the adjacent GIWs, and the TMPs closer to the GIW generally had lower temperatures than those farther from the GIWs, indicating a localized cooling effect from the HES.

#### Collected Gas Quality

**Four of 14 GEWs exhibited elevated balance gas concentrations (ranging between about 40% and 55%) at least once during March. O<sub>2</sub> concentrations in these wells were all low except at two wells (GEW-38 and -110) in comparison to the amount of balance gas present, which suggests possible air intrusion.** The other wells generally exhibited gas concentrations consistent with anaerobic conditions with balance gas concentrations < 20% and O<sub>2</sub> < 10%.

**All 13 GIWs exhibited elevated concentrations of balance gas (ranging between about 20% and 75%) and/or CO<sub>2</sub> (between about 6% and 70%).** Elevated balance gas concentrations were observed during the entire month and the majority of GIWs had measured concentrations > 20%, with a maximum of approximately 74% at GIW-4. Some GIWs showed elevated balance gas and elevated O<sub>2</sub>, suggesting potential air intrusion at the well (GIW-2, -3, -4, -7, -9, -12), while several GIWs (GIW-1, -5, -6, -8, -10, -11, -13) had elevated balance gas, but low O<sub>2</sub> content. This suggests possible air intrusion into the waste. CH<sub>4</sub> concentrations were generally < 20% for the GIWs.

### Settlement

Limited elevation points were measured in the Neck Area, thus no assessment of settlement rates in the Neck Area is made here.

### South Quarry

#### Temperature

- **No GEWs with data had temperatures > 200 °F. Thirty-one wells had measured temperatures ranging from 140 °F to 200 °F. Seventeen wells had measured temperatures < 100 °F.**
- **51 wells maintained an applied vacuum of at least 2" w.c. for the whole month.**
- **Two TMPs (TMP-31 and TMP-32) were examined. Generally, temperatures were steady or slightly increasing, with notable increases at the 160-ft depth at TMP-31 and the 200-ft depth at TMP-32.**

#### Collected Gas Quality

**No GEWs in the South Quarry exhibited gas concentrations consistent with anaerobic waste decomposition conditions.**

### Settlement

The maximum surface settlement in March was 1.35 ft, which is the same monthly settlement observed in February. Surface elevation points reported in March were compared to surface elevation points collected in February, and a volume difference was calculated by analyzing surfaces created with both sets of data points using a computer-aided design (CAD) program. The analysis showed a volume decrease of approximately 14,000 cubic yards (yd<sup>3</sup>) from February to March. This is less than the approximately 16,000 yd<sup>3</sup> volume loss from January to February of this year. This value should be considered an estimate since there were some settlement points missing from this month's data and details on surface filling or removal activities were not available in the site's monthly report narrative.